Noble gas signatures in Greenland: Tracing glacial meltwater sources

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We present the first results from a noble gas study carried out in glacial meltwater from the Greenland Ice Sheet (GrIS). Thirteen samples were collected and analyzed for noble gas concentrations and isotopic ratios at five different locations in southern Greenland, ranging between sea level and 1221 m. These include three supraglacial meltwater, eight subglacial discharge, and two proglacial stream water.

Our study shows that most GrIS meltwater samples are in disequilibrium with surface collection conditions. Two patterns are observed. The first one presents a Ne depletion and/or relative Ar enrichment with respect to Ne, Kr, and Xe, a pattern first observed in high-altitude springs in the Galápagos Islands [1]. The second one displays a mass-dependent depletion pattern, a pattern previouly observed in Michigan rainwater samples [2].

A preliminary Ne and Xe analysis suggests that about half of the samples equilibrated at a temperature of ~0°C and altitudes between 1000 m and 2000 m, with a few samples pointing to lower equilibration altitudes and temperatures between 2°C and 5°C. Two samples suggest an origin as melted ice and complete lack of equilibration with surface conditions.

A helium component analysis suggests that this glacial meltwater was isolated from the atmosphere prior to the 1950's, with most samples yielding residence times ≤ 424 yrs while two terminus samples yield residence times of 1877 yrs and 3586 yrs. Most samples represent a mixture between a dominant atmospheric component originating as precipitation and basal meltwater or groundwater which has accumulated crustal ^{4}He over time.

[1] Warrier et al. (2012) *Water Resour. Res.* **48**, W03508, doi: 10.1029/2011WR010954. [2] Warrier et al. (2013) *Geophys. Res. Lett.* **40**, doi: 10.1002/grl/50610.